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Competition ends in 15 days



**Tapioca DAO**  
The first ever Omnichain money market, powered by LayerZero.

[View Repo](#)

Make a submission

Start date  
**5 Jul 1:00 PM**

End date  
**4 Aug 1:00 PM**

Total awards  
**\$390,000 USDC**

Duration  
**about 1 month**

Details

Your Findings

## Tapioca audit details

- Total Prize Pool: \$390,000 USDC
  - HM awards: \$222,338 USDC
  - Analysis awards: \$13,476 USDC

- QA awards: \$6,737 USDC
  - Bot Race awards: \$20,212 USDC
  - Gas awards: \$6,737 USDC
  - Judge awards: \$26,000 USDC
  - Lookout awards: \$12,000 USDC
  - Scout awards: \$500 USDC
  - Mitigation Review: \$82,000 USDC (*Opportunity goes to top 5 certified wardens based on placement in this audit.*)
- Join [C4 Discord](#) to register
  - Submit findings [using the C4 form](#)
  - [Read our guidelines for more details](#)
  - Starts July 05, 2023 20:00 UTC
  - Ends August 04, 2023 20:00 UTC

## Automated Findings / Publicly Known Issues

Automated findings output for the audit can be found [here](#). **!Important:** click "Raw" to view the entire report, as it is truncated in the default view.

*Note for C4 wardens: Anything included in the automated findings output is considered a publicly known issue and is ineligible for awards.*

We are aware of the issue with the `_1d2sdRate()`. Currently if `isLdChain` isn't set to true for the chain within the deployment of the token, the maximum amount of token that can be sent is equal to `18e18`.

Prior audits can be viewed [here](#), and the contents of these are also considered known issues and ineligible for awards. It is recommended that wardens read both Certora reports for helpful context.

In particular, note that the issue described as "First depositor can steal value of some subsequent deposits" in the Certora audit is a known issue.

## Overview

The Tapioca protocol is built with a lot of different smart contracts, scattered across 5 repositories.

It's an *Omnichain* protocol working the LayerZero messaging layer. At its core, Tapioca ERC20/ERC721 contracts uses the LayerZero [OFTv2](#) and [ONFT721](#) contracts.

The main repository is [tapioca-bar](#), which contains [USDO](#), a stablecoin. [BigBang](#), a CDP based contract that mint and burn USDO . And [Singularity](#), a lending and borrowing platform.

The other repos are here to support the ecosystem as well as to create a synergy between the tokenomics and the protocol features.

- [tap-token](#) Contracts related to the tokenomics, is linked to `tapioca-bar` in an asymmetric way.
- [tapiocaz](#) Contracts that contains a wrapper named `T0FT` , which is used to wrap gas tokens and transfer allow their usage through the LayerZero network.
- [tapioca-periph](#) Periphery contracts. The main contract is `MagnetarV2` , acts as a helper that reduce the number of user taken actions/transactions.
- [YieldBox](#) A "BentoBox v2". Acts as a vault, that allow for yield strategies to be applied on the asset.
- [yieldbox-strategies](#) Yield strategies that will be used by a YieldBox asset.





















tapioca-userflow

## Notes

- The docs provide a lot of information about the protocol and the user flow, given the size of the protocol, we encourage checking it at <https://docs.tapioca.xyz/tapioca/>.
- MagnetarV2 does not have access control by design. The underlying is the one that implement those (Can be found on T0FT , Singularity , USD0 , TapiocaOptionBroker ).
- Re-entrancy on ownable contract should be considered as a vulnerability only if the last call leads to an external call with potential vulnerability.

## Files in scope

File	<a href="#">SLO C</a>	Description	Libraries
<i>Contracts (17)</i>			
<a href="#">tapioca-bar-audit/contracts/markets/singularity/SGLCollateral.sol</a>	<a href="#">22</a>	Singularity collateral module	
<a href="#">tapioca-bar-audit/contracts/markets/singularity/SGLBorrow.sol</a>	<a href="#">31</a>	Singularity borrowing module	
<a href="#">tapioca-bar-audit/contracts/usd0/BaseUSDStorage.sol</a> 📄 💰 📊	<a href="#">56</a>	Base USD0 contract	tapioca-sdk/* <a href="#">@openzeppelin/*</a> <a href="#">tapioca-periph/*</a>
<a href="#">tapioca-bar-audit/contracts/usd0/USD0.sol</a>	<a href="#">69</a>	USD0 stablecoin	tapioca-sdk/* <a href="#">tapioca-periph/*</a>
<a href="#">tapioca-bar-audit/contracts/markets/singularity/SGLLendingCommon.sol</a> 🏠	<a href="#">78</a>	Singularity base contract	
<a href="#">tapioca-bar-audit/contracts/markets/singularity/SGLStorage.sol</a>	<a href="#">121</a>	Singularity storage layout	<a href="#">@boringcrypto/*</a> <a href="#">tapioca-periph/*</a> tapioca-sdk/*











File	SL O C	Description	Libraries
<a href="#">tapioca-bar-audit/contracts/markets/singularity/SGLLeverage.sol</a>  	<a href="#">135</a>	Singularity module for leverage	<a href="#">tapioca-periph/*</a>
<a href="#">tapioca-bar-audit/contracts/markets/MarketERC20.sol</a> 	<a href="#">181</a>	Base contract for Market.sol	<a href="#">@boringcrypto/*</a> <a href="#">@openzeppelin/*</a>
<a href="#">tapioca-bar-audit/contracts/markets/singularity/SGLCommon.sol</a> 	<a href="#">209</a>	Singularity base contract	
<a href="#">tapioca-bar-audit/contracts/usd0/modules/USDOMarketModule.sol</a>    $\Sigma$	<a href="#">268</a>	USDO Module for Singularity	<a href="#">tapioca-sdk/*</a> <a href="#">@boringcrypto/*</a> <a href="#">tapioca-periph/*</a>
<a href="#">tapioca-bar-audit/contracts/usd0/modules/USDOOptionsModule.sol</a>    $\Sigma$	<a href="#">269</a>	USDO Module for TapiocaBrokerOption.sol calls	<a href="#">tapioca-sdk/*</a> <a href="#">tapioca-periph/*</a>
<a href="#">tapioca-bar-audit/contracts/usd0/modules/USDOLeverageModule.sol</a>    $\Sigma$	<a href="#">277</a>	USDO Module for leverage	<a href="#">tapioca-sdk/*</a> <a href="#">tapioca-periph/*</a>
<a href="#">tapioca-bar-audit/contracts/markets/singularity/SGLLiquidation.sol</a> 	<a href="#">288</a>	Singularity module for liquidations	
<a href="#">tapioca-bar-audit/contracts/usd0/BaseUSDO.sol</a>  	<a href="#">358</a>	Custom LayerZero OFT logic, inherited in USDO	<a href="#">tapioca-sdk/*</a> <a href="#">@openzeppelin/*</a> <a href="#">tapioca-periph/*</a>
<a href="#">tapioca-bar-audit/contracts/Penrose.sol</a>     $\Sigma$	<a href="#">377</a>	Owner contract for USDO & BB	<a href="#">@boringcrypto/*</a> <a href="#">tapioca-sdk/*</a> <a href="#">tapioca-periph/*</a>

File	SL O C	Description	Libraries
<a href="#">tapioca-bar-audit/contracts/markets/singularity/Singularity.sol</a> 💰 👤	<a href="#">4</a> <a href="#">52</a>	Lending & borrowing	<a href="#">tapioca-periph/*</a> <a href="#">tapioca-sdk/*</a>
<a href="#">tapioca-bar-audit/contracts/markets/BigBang/BigBang.sol</a> 🔒 👤	<a href="#">55</a> <a href="#">5</a>	Mint and burn USDO through CDP	<a href="#">@boringcrypto/*</a> <a href="#">tapioca-periph/*</a>
<i>Abstracts (1)</i>			
<a href="#">tapioca-bar-audit/contracts/markets/Market.sol</a> 📖	<a href="#">31</a> <a href="#">6</a>	Base contract for BigBang & Singularity	<a href="#">@boringcrypto/*</a> <a href="#">tapioca-sdk/*</a> <a href="#">tapioca-periph/*</a>
Total (over 18 files):	<a href="#">4</a> <a href="#">0</a> <a href="#">62</a>		

File	SL O C	Description	Libraries
<i>Contracts (10)</i>			
<a href="#">tapiocaz-audit/contracts/tOFT/TapiocaOFT.sol</a> 💰	<a href="#">5</a> <a href="#">0</a>	OFTv2 compliant wrapped token, with new custom functions	
<a href="#">tapiocaz-audit/contracts/tOFT/BaseTOFTStorage.sol</a> 📖 💰	<a href="#">55</a>	Base TOFT EVM storage layout	<a href="#">tapioca-sdk/*</a> <a href="#">@openzeppelin/*</a> <a href="#">tapioca-periph/*</a>
<a href="#">tapiocaz-audit/contracts/tOFT/mTapiocaOFT.sol</a> 💰	<a href="#">9</a> <a href="#">4</a>	Special TOFT implementation that can balance its supply	
<a href="#">tapiocaz-audit/contracts/TapiocaWrapper.sol</a> 💰 📊	<a href="#">14</a> <a href="#">1</a>	TOFT create2 deployer	<a href="#">tapioca-periph/*</a> <a href="#">@openzeppelin/*</a>

File	<u>SL</u> <u>O</u> <u>C</u>	Description	Libraries
<a href="#">tapiocaz-audit/contracts/tOFT/modules/BaseTOFTStrategyModule.sol</a> 💰 👤	<u>2</u> <u>0</u> <u>3</u>	Base TOFT YieldBox module	<a href="#">tapioca-sdk/*</a> <a href="#">tapioca-periph/*</a>
<a href="#">tapiocaz-audit/contracts/Balancer.sol</a> 💰	<u>22</u> <u>3</u>	Contract that balance out a mTapiocaOFT supply	<a href="#">tapioca-periph/*</a> <a href="#">solmate/*</a> <a href="#">@openzeppelin/*</a>
<a href="#">tapiocaz-audit/contracts/tOFT/modules/BaseTOFTMarketModule.sol</a> 💰 👤 ♻️ Σ	<u>27</u> <u>6</u>	Base TOFT Singularity market module	<a href="#">tapioca-sdk/*</a> <a href="#">tapioca-periph/*</a>
<a href="#">tapiocaz-audit/contracts/tOFT/modules/BaseTOFTOptionsModule.sol</a> 💰 👤 ♻️ Σ	<u>2</u> <u>83</u>	Base TOFT TapiocaOptionBroker market module	<a href="#">tapioca-sdk/*</a> <a href="#">tapioca-periph/*</a>
<a href="#">tapiocaz-audit/contracts/tOFT/modules/BaseTOFTLeverageModule.sol</a> 💰 👤 ♻️ Σ	<u>3</u> <u>0</u> <u>5</u>	Base TOFT leverage module	<a href="#">tapioca-sdk/*</a> <a href="#">tapioca-periph/*</a>
<a href="#">tapiocaz-audit/contracts/tOFT/BaseTOFT.sol</a> 💰 👤	<u>4</u> <u>55</u>	Base TOFT contract	
Total (over 10 files):	<u>2</u> <u>0</u> <u>8</u> <u>5</u>		

File	<u>SL</u> <u>O</u> <u>C</u>	Description	Libraries
<i>Contracts (9)</i>			
<a href="#">tap-token-audit/contracts/tokens/LTap.sol</a> 🏠	<u>3</u> <u>0</u>	ERC20 aoTAP 1:1 redeemer	<a href="#">@boringcrypto/*</a> <a href="#">@openzeppelin/*</a>

File	SL O C	Description	Libraries
<a href="#">tap-token-audit/contracts/options/oTAP.sol</a>	<a href="#">75</a>	ERC721 Option meta contract	<a href="#">@boringcrypto/*</a> <a href="#">@openzeppelin/*</a> <a href="#">tapioca-sdk/*</a>
<a href="#">tap-token-audit/contracts/option-airdrop/aoTAP.sol</a>	<a href="#">88</a>	Forked version of oTAP	<a href="#">@boringcrypto/*</a> <a href="#">@openzeppelin/*</a> <a href="#">tapioca-sdk/*</a>
<a href="#">tap-token-audit/contracts/Vesting.sol</a>	<a href="#">94</a>	Vesting contract	<a href="#">@openzeppelin/*</a> <a href="#">@boringcrypto/*</a>
<a href="#">tap-token-audit/contracts/tokens/TapOFT.sol</a>	<a href="#">127</a>	Tapioca protocol token	<a href="#">@openzeppelin/*</a>
<a href="#">tap-token-audit/contracts/options/TapiocaOptionLiquidityProvision.sol</a>   $\Sigma$	<a href="#">248</a>	Singularity ERC20 receipt token vault	<a href="#">@boringcrypto/*</a> <a href="#">@openzeppelin/*</a> <a href="#">tapioca-sdk/*</a>
<a href="#">tap-token-audit/contracts/option-airdrop/AirdropBroker.sol</a>   $\Sigma$	<a href="#">338</a>	Smaller version of TapiocaOptionBroker to mint & exercise LTAP	<a href="#">@openzeppelin/*</a> <a href="#">@boringcrypto/*</a> <a href="#">tapioca-periph/*</a>
<a href="#">tap-token-audit/contracts/governance/twTAP.sol</a>   $\Sigma$	<a href="#">341</a>	ONFT721 governance token	<a href="#">tapioca-sdk/*</a> <a href="#">@openzeppelin/*</a>
<a href="#">tap-token-audit/contracts/options/TapiocaOptionBroker.sol</a>  $\Sigma$	<a href="#">398</a>	Mint & exercise oTAP	<a href="#">@boringcrypto/*</a> <a href="#">@openzeppelin/*</a> <a href="#">tapioca-periph/*</a>
<i>Abstracts (2)</i>			
<a href="#">tap-token-audit/contracts/twAML.sol</a>  $\Sigma$	<a href="#">94</a>	Math library	
<a href="#">tap-token-audit/contracts/tokens/BaseTapOFT.sol</a>   $\Sigma$	<a href="#">264</a>	Base TapOFT contract	<a href="#">tapioca-sdk/*</a> <a href="#">@openzeppelin/*</a>



File	<a href="#">SL</a>	Description	<a href="#">tapioca-periph/*</a>
Total (over 11 files):	<a href="#">0</a> <a href="#">2</a> <a href="#">0</a> <a href="#">97</a>		





File	<a href="#">SL</a> <a href="#">O</a> <a href="#">C</a>	Description	Libraries
<i>Contracts (12)</i>			
<a href="#">tapioca-periph-audit/contracts/oracle/implementations/GLPOracle.sol</a>	<a href="#">38</a>	GLP Oracle	
<a href="#">tapioca-periph-audit/contracts/TapiocaDeployer/TapiocaDeployer.sol</a>   	<a href="#">52</a>	Tapioca contract deployer	
<a href="#">tapioca-periph-audit/contracts/oracle/implementations/SGOracle.sol</a>	<a href="#">57</a>	Stargate finance oracle	<a href="#">@chainlink/*</a>
<a href="#">tapioca-periph-audit/contracts/oracle/SeeR.sol</a>	<a href="#">66</a>	Oracle contract, uses best of ChainLink/UniV3 price feed	
<a href="#">tapioca-periph-audit/contracts/Multicall/Multicall3.sol</a>   	<a href="#">72</a>	Multicall contract	<a href="#">@openzeppelin/*</a>
<a href="#">tapioca-periph-audit/contracts/oracle/implementations/ARBTriCryptoOracle.sol</a>	<a href="#">87</a>	TriCrypto oracle	<a href="#">@chainlink/*</a> <a href="#">@openzeppelin/*</a> <a href="#">solady/*</a>
<a href="#">tapioca-periph-audit/contracts/Swapper/CurveSwapper.sol</a>	<a href="#">108</a>	Curve swapper contract	<a href="#">@openzeppelin/*</a>
<a href="#">tapioca-periph-audit/contracts/Swapper/UniswapV2Swapper.sol</a>	<a href="#">121</a>	UniV2 swapper contract	

File	<a href="#">SL</a> <a href="#">O</a> <a href="#">C</a>	Description	Libraries
<a href="#">tapioca-periph-audit/contracts/Swapper/UniswapV3Swapper.sol</a>	<a href="#">14</a> <a href="#">2</a>	UniV3 swapper contract	<a href="#">@uniswap/*</a> <a href="#">@openzeppelin</a> <a href="#">/*</a>
<a href="#">tapioca-periph-audit/contracts/Magnetar/MagnetarV2Storage.sol</a> 💰	<a href="#">2</a> <a href="#">8</a> <a href="#">4</a>	Magnetar storage layout	<a href="#">@boringcrypto</a> <a href="#">/*</a> tapioca- sdk/*
<a href="#">tapioca-periph-audit/contracts/Magnetar/modules/MagnetarMarketModule.sol</a> 💰 📄 🌱	<a href="#">67</a> <a href="#">6</a>	Magnetar Singularity module	tapioca-sdk/* <a href="#">@openzeppelin</a> <a href="#">/*</a>
<a href="#">tapioca-periph-audit/contracts/Magnetar/MagnetarV2.sol</a> 📄 💰 👤 <a href="#">Σ</a>	<a href="#">8</a> <a href="#">6</a> <a href="#">6</a>	Helper contract that interacts with Singularity, BigBang, TapiocaOptionBroker	<a href="#">@openzeppelin</a> <a href="#">/*</a>
<i>Abstracts (1)</i>			
<a href="#">tapioca-periph-audit/contracts/Swapper/BaseSwapper.sol</a>	<a href="#">15</a> <a href="#">1</a>	Base swapper contract for other swapper contract	<a href="#">@openzeppelin</a> <a href="#">/*</a> tapioca- sdk/*
Total (over 13 files):	<a href="#">27</a> <a href="#">2</a> <a href="#">0</a>		

File	<a href="#">SL</a> <a href="#">O</a> <a href="#">C</a>	Description	Libraries
<i>Contracts (10)</i>			
<a href="#">tapioca-yieldbox-strategies-audit/contracts/yearn/YearnStrategy.sol</a>	<a href="#">82</a>	Yearn strat	<a href="#">@openzeppelin/*</a> <a href="#">@boringcrypto/*</a> tapioca-sdk/*
<a href="#">tapioca-yieldbox-strategies-audit/contracts/compound/CompoundStrategy.sol</a> 💰	<a href="#">94</a>	Compound strat	<a href="#">@openzeppelin/*</a> <a href="#">@boringcrypto/*</a> tapioca-sdk/*

File	SL OC	Description	Libraries
<a href="#">tapioca-yieldbox-strategies-audit/contracts/lido/LidoEthStrategy.sol</a> 💰	<a href="#">100</a>	TriCrypto LP strat	<a href="#">@openzeppelin/*</a> <a href="#">@boringcrypto/*</a> tapioca-sdk/*
<a href="#">tapioca-yieldbox-strategies-audit/contracts/curve/TricryptoNativeStrategy.sol</a>	<a href="#">175</a>	TriCrypto native strat	<a href="#">@openzeppelin/*</a> <a href="#">@boringcrypto/*</a> tapioca-sdk/*
<a href="#">tapioca-yieldbox-strategies-audit/contracts/curve/TricryptoLPStrategy.sol</a>	<a href="#">176</a>	TriCrypto LP strat	<a href="#">@openzeppelin/*</a> <a href="#">@boringcrypto/*</a> tapioca-sdk/*
<a href="#">tapioca-yieldbox-strategies-audit/contracts/stargate/StargateStrategy.sol</a> 💰	<a href="#">182</a>	Stargate strat	<a href="#">@openzeppelin/*</a> <a href="#">@boringcrypto/*</a> tapioca-sdk/*
<a href="#">tapioca-yieldbox-strategies-audit/contracts/aave/AaveStrategy.sol</a>	<a href="#">190</a>	Stargate strat	<a href="#">@openzeppelin/*</a> <a href="#">@boringcrypto/*</a> tapioca-sdk/*
<a href="#">tapioca-yieldbox-strategies-audit/contracts/balancer/BalancerStrategy.sol</a> 💰	<a href="#">208</a>	Balancer strat	<a href="#">@openzeppelin/*</a> <a href="#">@boringcrypto/*</a> tapioca-sdk/*
<a href="#">tapioca-yieldbox-strategies-audit/contracts/glp/GlpStrategy.sol</a> 🧪 🌱	<a href="#">240</a>	GLP strat	<a href="#">@boringcrypto/*</a> <a href="#">@uniswap/*</a> tapioca-sdk/*
<a href="#">tapioca-yieldbox-strategies-audit/contracts/convex/ConvexTriCryptoStrategy.sol</a> 📊	<a href="#">289</a>	TriCrypto strat	<a href="#">@openzeppelin/*</a> <a href="#">@boringcrypto/*</a> tapioca-sdk/*
Total (over 10 files):	<a href="#">1736</a>		

File	SL OC	Description	Libraries
<i>Contracts (3)</i>			

File	<a href="#">SL</a> <a href="#">OC</a>	Description	Libraries
<a href="#">YieldBox/contracts/NativeTokenFactory.sol</a>	<a href="#">72</a>	Creates ERC1155 tokens	
<a href="#">YieldBox/contracts/YieldBoxURIBuilder.sol</a>	<a href="#">123</a>	Inherited by YieldBox	<a href="#">@openzeppelin/*</a> <a href="#">@boringcrypto/*</a>
<a href="#">YieldBox/contracts/YieldBox.sol</a>  	<a href="#">263</a>	Main Yieldbox contract	<a href="#">@boringcrypto/*</a> <a href="#">@openzeppelin/*</a>
<i>Abstracts (1)</i>			
<a href="#">YieldBox/contracts/YieldBoxPermit.sol</a> 	<a href="#">67</a>	EIP-2612 for YieldBox	<a href="#">@openzeppelin/*</a>
<i>Libraries (2)</i>			
<a href="#">YieldBox/contracts/BoringMath.sol</a>	<a href="#">26</a>	Simple math lib	
<a href="#">YieldBox/contracts/YieldBoxRebase.sol</a> 	<a href="#">40</a>	Math lib for internal accounting	<a href="#">@boringcrypto/*</a>
Total (over 6 files):	<a href="#">591</a>		

## Out of scope

- [@boringcrypto/boring-solidity/contracts](#)
- [@openzeppelin/contracts/](#)
- [@chainlink/](#)
- [solady/](#)
- [@rari-capital/solmate](#)

## Additional Context

twAML is a simple model that is used in twTAP and TapiocaOptionBroker. A detailed explanation of how it works can be found [here](#).

## Scoping Details

- If you have a public code repo, please share it here: <https://github.com/Code4rena/tapioca-dao>
- How many contracts are in scope?: 62
- Total SLoC for these contracts?: 13499
- How many external imports are there?: 15
- How many separate interfaces and struct definitions are there for
- Does most of your code generally use composition or inheritance?
- How many external calls?: 10
- What is the overall line coverage percentage provided by your tests?
- Is there a need to understand a separate part of the codebase / {
- Please describe required context: n/a
- Does it use an oracle?: Custom oracle that may use Chainlink or
- Does the token conform to the ERC20 standard?: True / also non-E
- Are there any novel or unique curve logic or mathematical models?
- Does it use a timelock function?: True
- Is it an NFT?:
- Does it have an AMM?:
- Is it a fork of a popular project?: True; Heavily modified version
- Does it use rollups?:
- Is it multi-chain?: True
- Does it use a side-chain?: False
- Describe any specific areas you would like addressed. E.g. Please

Tap-Token repo:

Integrity of twAML model within the used contracts (TapiocaOptionBr  
Correct user participation and exit on twAML contracts (tOB, tDP).  
Proper OTC deal execution on tOB.

Tapioca-Bar repo:

Lending & borrowing mechanism.

Function access with lend/borrow approval/permit.

Closed liquidations.

TapiocaZ repo:

mTapiocaOFT/Balancer contract balancing mechanism.

## QuickStart

```
export ALCHEMY_API_KEY="<your-alchemy-api-key>" && export PRIVATE_KEY="<your-private-key>"
```

## Tests

Some tests are skipped, either because it requires a specific chain to be on (Some tests might run solely on Mainnet, while others on Arbitrum). Others are skipped due to being there for helping purposes, or being too old but aren't cleaned.

## Hardhat tests:

### Setup

```
yarn
npx hardhat compile
```

### Test

```
npx hardhat test
```

### Gas cost

Set enabled key to true in `hardhat.export.ts>config.gasReporter`

```
gasReporter: {
  enabled: true,
}
```

## Slither

Slither does not currently work on `tapioca-periph-audit` repo. If you find a workaround, please share in the discord.

# Coverage

Coverage is broken for some repos because we use `IR` compilation.  
Disabling it might output a stack too deep compilation error.

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[code4rena.eth](#)